Chapter 6 – DEVELOPMENT AND SCREENING OF ALTERNATIVES

6.1 Introduction

This chapter combines the technologies and process options, retained from the Chapter 4 screening, into working remedial alternatives. These alternatives are further screened by evaluating to what degree the alternatives can reduce the potential for exposure identified in the RA. Each alternative was evaluated for all remediation units. Those alternatives that meet the screening criteria and can be effectively applied to Site soils were retained for detailed analysis in Chapter 7. The remedial alternatives applicable to Miscellaneous Small Remediation Units are described in Section 8.3.

Section 6.2 describes the alternative screening criteria. Section 6.3 assembles the technologies and process options retained from Chapter 4 into remedial alternatives. Section 6.4 describes and screens each alternative, and Section 6.5 ranks the alternatives based on the outcome of the screening process. Section 6.6 presents a summary of the alternatives retained for detailed analysis in Chapter 7.

6.2 Screening Criteria

Like the initial technology screening, alternative screening was based on three criteria: effectiveness, implementability, and cost (as described in Section 4.3.3). Figure 6-1 shows the relationship between these three screening criteria and the eight MTCA evaluation criteria used in the detailed analysis of alternatives in Chapter 7. Unlike the initial technology screening, the relative importance of the criteria are different, with more emphasis on the effectiveness of the alternative in attaining the RAOs and cleanup standards and less emphasis on implementability and cost. Effectiveness was emphasized because it encompasses five of the seven evaluation criteria used in Chapter 7 and because MTCA guidance places particular importance on permanence, one of the sub-criteria of effectiveness.

6.2.1 Effectiveness

For alternative screening, effectiveness is the primary criterion. Key sub-criteria (of effectiveness) used in the screening of alternatives are listed below. The protection of human health and the environment, and compliance with cleanup standards as listed in WAC 173-340-700 and/or WAC 173-340-7490(6)(f) are "threshold criteria" since they must be met by the alternative for it to be retained for further evaluation in Chapter 7. Those alternatives that did not meet these threshold criteria (with the exception of No Action) were not retained for further evaluation. The sub-criteria of effectiveness used to assess effectiveness are defined as:

Protectiveness: This evaluation considers the overall protection each technology provides to human health and the environment including the degree to which existing risks are reduced, the time required to reduce risk and obtain cleanup standards, the off-Site and on-Site risks resulting from the implementation of the alternative and the degree of improvement of the overall environmental quality.

Permanence: This evaluation considers the degree to which the alternative permanently reduces the toxicity, mobilization or volume of the contaminants including the adequacy of the alternative/technology in reducing or elimination of releases of the contaminant, degree to which the treatment is irreversible, and the characteristics and quantity of the treatment residuals generated. Since lead and arsenic are the contaminants of concern, one of the MTCA criteria, destruction, is not obtainable by any of the listed alternatives and will not be evaluated.

Long-Term Effectiveness: This evaluation considers the effectiveness and reliability of the process during the time when contaminant concentrations remain on site that are greater than cleanup levels including the magnitude of risk with the alternative in place, the degree of certainty that the alternative/technology will be successful, and the adequacy and reliability of any Site controls.

Management of Short-Term Risks: This evaluation considers the effectiveness of the process dealing with the potential impacts to human health and the environment during the construction and implementation phase and the effectiveness of the measures to manage such risks.

6.2.2 Implementability

Implementability includes both operational implementability and administrative feasibility. Operational implementability refers to the ability to construct and reliably operate the remediation alternative. It includes operation, maintenance, replacement, and monitoring of the technical components of an alternative. Administrative feasibility refers to the ability to obtain approvals from city/county/state officials/agencies, the availability of treatment, storage, and disposal services, and the availability of specific equipment.

6.2.3 Cost

The alternatives screening cost estimates were developed from a variety of sources including technology unit costs developed by the project team, vendor information, published cost-estimating guides, and prior experience with similar technologies. In this evaluation, treatment includes construction and treatment activities necessary for attaining the RAOs. The screening level cost estimates do not include the contingency, administration, maintenance, or long-term monitoring costs since these costs will not impact the relative cost differences between alternatives unless the alternative does not include long-term monitoring. These cost estimates are used for the screening of the alternatives only and should not be considered to represent the total remediation cost associated with the cleanup of the Site. Estimated costs presented in this chapter represent the direct cost that would be realized if the alternative being evaluated were implemented to address the total volume of contaminated soil listed in Chapter 3. Table 6-1 lists these costs. Chapter 7 presents the potential total costs for implementation of the alternatives that were retained for the detailed analysis.

6.2.4 Consideration of Public Concerns

MTCA calls for the evaluation of local community potential concerns over the alternative and how the alternative addresses those concerns. For this FS it has been determined that with the exception of the No Action Alternative, each of the remaining alternatives share the common public concerns of protection of cultural and historical sites and artifacts, long-term public health, and short-term public health. The latter two are key components of Long-Term Effectiveness and Management of Short-Term Risks and will be addressed under those headings. A cultural resource protection program has been in place at the Site for many years and will be followed during the cleanup. The cultural protection plan will also be a key component of the Cleanup Action Plan for this site. Since the same amount of soil excavation will be required, little, if any, difference exists between the action-related alternatives in addressing cultural resource concerns. As such, we will focus on concerns that are unique to each alternative but not those that are “global” in nature.

6.2.5 Ecology Cleanup Technology Preference

Ecology summarizes its cleanup technology preference guidance for the selection of remedial alternatives in WAC 173-340-350 (8)(c)(i)(C). The guidance sets a relative ranking for technologies. The following technologies are listed in order of descending preference by Ecology:

- Reuse or recycling;
- Destruction or detoxification;
- Separation or volume reduction, in combination with reuse, recycling, destruction, or detoxification;
- Immobilization;

- On-Site or off-Site disposal;
- On-Site isolation or containment; and
- Institutional controls and monitoring.

6.3 Assembly of Alternatives - Groundwater

Two alternatives have been selected for the remediation of groundwater; natural restoration and active groundwater treatment. Chapter 7 will further evaluate these alternatives and describe the preferred alternative.

6.3.1 Description and Screening of Alternatives – Groundwater

Active Groundwater Treatment: Available technologies for the active treatment of impacted groundwater are very limited and would require, for this Site, the pumping of very large quantities (up to 7,000 gallons per minute) of water. Groundwater pump and treat is the only active groundwater remediation technology which could be applied at the Site for the following reasons:

- Groundwater which would be targeted for remediation is deep (100 to 200 feet below surface) and laterally extensive. preventing use of impermeable barriers, gates, or other groundwater isolation techniques;
- DNT (the single contaminant) has low volatility, preventing use of sparging or other venting technologies ;
- Although DNT can be degraded through natural in situ processes, only biological degradation could potentially occur in Site aquifers and attempting to enhance this process as part of a remediation program would likely be infeasible;
- DNT readily degrades by photolysis (half-life on the order of days; Etnier, 1987), but this process will not occur in aquifers;
- DNT can be transformed to formic and acetic acids, but only at temperatures at which water would not persist (520°F; Etnier, 1987); and
- DNT in water degrades through biological processes under some aerobic and anaerobic conditions (Spanggord. 1980; Etniert 1987), but the metabolism of DNT is strongly dependent on environmental conditions and the presence of viable microorganisms (ATSDR, 1989). Biodegradation of DNT may be occurring naturally in Site aquifers, yet attempting to establish or enhance appropriate natural microorganism populations (e.g. , by introducing nutrients) in Site aquifers would likely be infeasible because of the size of the Site and the substantial depth of the aquifers.

Natural Restoration: Natural restoration is the process in which the source of the contamination is removed and the water is left to clean itself up naturally. Active monitoring is typically a part of natural restoration.

6.4 Assembly of Alternatives - Soil

This FS defines alternatives for soils as a collection of technology process options that can be combined to effectively address a given remediation unit. In general, technologies/process options that are effective for one remediation unit are also effective for other remediation units. There are some exceptions to this; for example, the alternate chosen in ecologically or historically sensitive areas may not be the same as those within industrial or commercial areas.

Based on the initial screening of technologies (presented in Chapter 4) and the results of the treatability studies (presented in Chapter 5), the following alternatives were formulated and ranked independently for all remediation units:

- No Action;
- Capping;
- Cover;
- Cap/Cover;
- On Site Deposition, Cap and Cover;
- Off-Site Disposal at a Landfill;
- Wet Screening, Classification, and Disposal of the Residual Soils at a Landfill;
- Wet Screening with On-Site Deposition, Cap and Cover and Disposal of the Residual Soils at a Landfill;
- Wet Screening with Stabilization and On-Site Deposition and Cover;
- Soil Washing with Wet Screening, Classification, Acid/Base Extraction, and Disposal of the Residual Soils at a Landfill; and
- Soil Washing with Wet Screening, Classification, Chelant Extraction, and Disposal of the Residual Soils at a Landfill.

Ten potential remedial alternatives, in addition to No Action, were developed for the Site. Each alternative will attain varying degrees of risk reduction under the proposed land use plan.

6.5 Description and Screening of Alternatives

This section presents a brief description of each alternative and discusses the performance of each alternative against the three screening criteria. Alternatives which are most likely to attain the RAOs are identified for further evaluation in Chapter 7.

6.5.1 No Action

No action means that no remedial activities will be implemented to clean up the Site.

Effectiveness:

- Protectiveness: The No Action alternative does not attain the Site ecological or human health standards. As such this alternative will not meet cleanup standards as listed in either WAC 173-340-700 or WAC 173-340-7490(6)(f). Since no action would occur there would be no reduction in risk.
- Permanence: No action does not reduce toxicity, mobility or volume and is not a permanent solution.
- Long Term Effectiveness: Since this alternative does not attain cleanup standards or reduce risk, toxicity or mobility it is not effective over the long-term.

- Management of Short Term Risks: Since no activities occur under this alternative, short-term risks associated with implementation would not occur.

- Consideration of Public Concerns: No action would result in denied access to the Site. Development of commercial, historical and golf course land use areas would not be allowed by this alternative.

Implementability: This alternative does not meet the needs of the current Site development plans or Ecology's cleanup standards. Development of commercial, historical and golf course land use areas would be limited by this alternative. Since no construction activities will be required as part of this alternative, it could be readily implemented.

Cost: There is no initial remediation cost associated with the implementation of this alternative since no activities are performed.

Considerations: No Action does not have the ability to meet RAOs consistent with Ecology's ecological and human health standards but has the lowest initial cost. It was retained during the detailed analysis to provide comparison with other remedial alternatives.

6.5.2 Capping

Capping consists of the installation of a layer of highly durable, impermeable, engineered materials over the Site soils containing contaminant concentrations above the CL but below the RL. No excavation of soils would occur as part of this alternative.

Effectiveness:

- Protectiveness: Both Site wide and discrete area capping could meet cleanup standards as listed in WAC 173-340-7490(6)(f). Preventing direct contact exposure with soil above the CL would significantly reduce risk. The time frame for this action would be dependant upon the size of the area capped. Capping of the entire Site would require approximately 3.3 years. Off-Site risk would be limited to implementation (see Management of Short Term Risks) and ongoing on-Site risks would be minimal. The reduction in exposure risk would improve the overall environmental condition of the Site.

- Permanence: There would be no reduction in toxicity or volume. Mobility would be reduced due to the impermeable nature of the Cap material. Capping does not represent a permanent remedy.

- Long Term Effectiveness: Once complete, capping would greatly reduce residual risk. Long-term effectiveness of a capping remedy relies on an effective O&M program. Such programs can be effective with active management.

- Management of Short Term Risks: Since this alternative does not include the excavation of contaminated soils, short term exposure risk would be less than excavation related alternatives.

- Consideration of Public Concerns: Large scale capping would not meet the public's wish to return the property to viable use or Weyerhaeuser Real Estate's plans to develop the property. Lesser scale application could meet all concerns.

Implementability: Site wide capping could potentially result in limiting land use and development in the capping area. This alternative does not meet the current needs of the Site development plans. Capping is a common remedy and could be applied. Small-scale applications could be effectively implemented.

Cost: A direct cost range of $79 million (M) to $129.6M is estimated for implementation of this alternative. Long-term cap maintenance costs would also be incurred.

Considerations: Capping would be effective in meeting the RAOs for the Site but is not permanent. Capping also may restrict future Site development. It could be considered in small-scale areas where roads, asphalt trails, parking areas, or buildings are planned. It is also costly to apply. This alternative may have some limited use and will be retained for further evaluation in Chapter 7.

Adjustments to remediation levels: No adjustments to the remediation levels used in the RA are warranted for this alternative.

6.5.3 Cover

A cover involves the installation of a clean soil layer over areas of the Site that contain soil with concentrations of constituents above the CL but below the RL. The installation of a cover over these soils may meet the RAOs by reducing direct contact exposure. At a minimum the cover would equal 18 inches in depth for the protection of human health and 6 inches in depth (gravel only) for the protection of ecological receptors. No excavation of soils would occur as part of this alternative.

Effectiveness:

- Protectiveness: Both Site wide and discrete area cover could, depending on the thickness of the cover, meet cleanup standards as listed in WAC 173-340-7490(6)(f). Preventing direct contact exposure with soil above the CL would significantly reduce risk. The time frame for this action would be dependent upon the size of the area covered. Covering of the entire Site would require approximately 2.4 years. Off-Site risk would be limited to implementation (see Management of Short Term Risks) and ongoing on-Site risks would be minimal. The reduction in exposure risk would improve the overall environmental condition of the Site. The placement of a topsoil cover in golf course, treeless open space, and historical land use areas could, depending on thickness, be an effective exposure barrier.

- Permanence: Cover, in itself, does not represent a permanent remedy. There would be no reduction in mobility, toxicity or volume.

- Long Term Effectiveness: The residual risk would be greatly reduced once a complete cover was in place. Long-term effectiveness of a cover remedy relies on an effective O&M program. Such programs can be effective with active management.

- Management of Short Term Risks: Since this alternative does not include the excavation of contaminated soils, short term exposure risk would be less than excavation related alternatives.

- Consideration of Public Concerns: Total Site cover would not meet the public's wish to return the property to viable use or Weyerhaeuser Real Estate's plans to develop the property. Lesser scale applications could meet all concerns.

Implementability: This alternative can meet the current needs of the Site development plans in areas where treeless open space, historical, or golf course land uses are planned. Installation of a soil cover across broad areas may be difficult to implement because of development restrictions in the covered area and the availability of cover material. Cover over smaller areas can be easily completed since smaller quantities of soils are readily available on Site and can be placed easily because of the typically flat topography of the Site.

Cost: A direct cost range of $43M to $72M is estimated for implementation of this alternative. Clean soil from on-Site sources makes the cost less for installation of soil cover in selected areas.

Considerations: Cover would be effective in meeting the RAOs for the Site, but is not permanent. Cover would also restrict future Site development. It could be considered on a small-scale in areas of environmental or historic sensitivity. As such, it was retained for further evaluation in Chapter 7.

Adjustments to remediation levels: No adjustments to the remediation levels used in the RA are warranted for this alternative.

6.5.4 Cap/Cover

Cap/Cover consists of the placement of 18 inches of soil over the Site soils containing contaminant concentrations above the CL but below the RL. The cap would consist of a layer of high durability, engineered materials or layer of gravel. A 12-inch to 18-inch soil cover would then be placed on top of the cap to further prohibit exposure to the underlying soils. The installation of the cap/cover would meet the RAOs by preventing direct contact exposure with soil above the CL. This combination would act as an exposure barrier to both ecological receptors and humans. No excavation of soils would occur as part of this alternative.

Effectiveness:

- Protectiveness: Cap/Cover could meet cleanup standards as listed in WAC 173-340-7490(6)(f) in both Site wide and smaller applications. Since cap/cover incorporates the best of both the cap and cover alternatives risk would be further reduced. The time frame for this action would be dependent upon the size of the area capped. Cap/Cover of the entire Site would require approximately 2.8 years. Off-Site risk would be limited to implementation (see Management of Short Term Risks) and ongoing on-Site risks would be minimal. The reduction in exposure risk would improve the overall environmental condition of the Site.

- Permanence: There would be no reduction in toxicity or mobility. This alternative does not represent a permanent remedy.

- Long Term Effectiveness: The residual risk would be greatly reduced once a complete cover was in place. Long-term effectiveness of a capping remedy relies on an effective O&M program. Such programs can be effective with active management.

- Management of Short Term Risks: Since this alternative does not include the excavation of contaminated soils, short term exposure risk would be less than excavation related alternatives

- Consideration of Public Concerns: Large-scale cap/cover would not meet the public's wish to return the property to viable use or Weyerhaeuser Real Estate's plans to develop the property. Restricting the use of this alternative to the golf course, open space, and historical land use areas would meet all concerns.

Implementability: Large scale capping could potentially result in limiting land use and development in the capped area. This alternative does not meet the current needs of the Site development plans. Isolated use of this alternative could be useful in preventing exposure to soil with contaminant concentrations above CLs. Capping is a common remedy and could be applied.

Cost: A direct cost range of $26.6M to $41.5M is estimated for implementation of this alternative. Long-term cap maintenance costs would also be incurred.

Considerations: Cap/Cover would be effective in meeting the RAOs for the Site, but is not permanent. Cap/Cover would also restrict future Site development and could be considered in golf course, historical areas and open space areas where exposure prevention and protection of habitat are desired. As such, it was retained for further evaluation in Section 7.

Adjustments to remediation levels: The risk-based remediation or cleanup levels used in the RA for soil located within the golf course and open space land use areas are based on frequency of exposure and do not consider the installation of a soil cover over impacted soil. The application of an engineered cap/cover will further reduce the potential risk of exposure thereby increasing the effective RL. Ecology has determined that the effective remediation levels for lead- and arsenic-contaminated soils in areas of the Site that will have a cap/cover are 4,100 mg/kg and 530 mg/kg, respectively. Justification of this decision is included in Appendix H.

6.5.5 On Site Deposition, Cap and Cover

On-Site Deposition, Cap and Cover includes the excavation of soils containing contaminant concentrations above the RL in one land use, transferring it to a land use area within the area of contamination (AOC) where it is below the RL for that land use, and using a cap/cover combination to prevent exposure. The cap would consist of a layer of high durability, engineered materials or layer of gravel over the deposited soils. A soil cover would then be placed on top of the cap to further prohibit exposure to the underlying soils. The installation of the cap/cover would meet the RAOs by preventing direct contact exposure with soil above the CL. Implementation of this alternative allows integration of the deposition of soil with the design of the golf course.

Effectiveness: On-Site deposition with cap/cover is allowed under MTCA and may be effective in meeting site cleanup standards and RAOs. Although volume and toxicity are not modified, soil would be placed in a land use area where the exposure risks are reduced based on restricted access and the protection afforded by the cap/cover.

- Protectiveness: This alternative would meet cleanup standards as listed in WAC 173-340-7490(6)(f). Risk would be reduced in two ways. The cap/cover would prevent direct exposure and the consolidation of the contaminated soils in a smaller area would lessen the probability of direct contact. The timeframe necessary to complete this action is approximately 2.8 years.

- Permanence: There would be no reduction in toxicity, or mobility. This alternative does not represent a permanent remedy.

- Long Term Effectiveness: Once complete this alternative would greatly reduce residual risk. Long-term effectiveness of a capping remedy relies on an effective O&M program. Such programs can be effective with active management. This alternative is particularly applicable within the golf course land use areas since the operations of a golf course would ensure the competence of the cap/cover.

- Management of Short Term Risks: Since this alternative includes excavation, it represents an increased risk when compared to non-excavation alternatives. It does represent the least risk of the alternatives that involve excavation. An aggressive dust control program and air monitoring could minimize short-term risks. These efforts have been successful in the past in controlling potential risks.

- Consideration of Public Concerns: This alternative would meet the public’s wish to return the property to viable use and WRECO’s plans to develop the property. Restricting the use of the alternative to the golf course land use areas would meet all concerns.

Implementability: If restricted to the golf course this alternative can meet the current needs of the Site development plans and can be easily implemented using conventional soils excavation, handling, and transportation equipment. Since the AOC has been defined by Ecology as the land inside the Consent Decree Boundary, soil could be deposited in areas where future Site development would not be restricted.

Cost: An approximate direct cost of $13M to $21.6M is estimated for implementation of this alternative. Clean soil from on-Site sources makes the cost of installation of a soil cover low.

Considerations: This alternative provides for placing soil in land use areas associated with lower exposure risks. This alternative would also consolidate the contaminated soils into discrete areas, and thus is more effective than wholesale covering or capping of the Site. Soil cover may restrict future Site development but not to the degree that whole cover or capping would. The volume of impacted soil would not be reduced.

Adjustments to remediation levels: A key component of this alternative is the installation of an 18-inch soil cap/cover (as described in Section 7.2.3) The risk-based remediation or cleanup levels used in the RA for soil located within the golf course and open space land use areas are based on frequency of exposure and do not consider the installation of a soil cover over impacted soil. The application of an engineered cap/cover will further reduce the potential risk of exposure thereby increasing the effective RL. Ecology has determined that the effective remediation levels for lead- and arsenic-contaminated soils in areas of the Site that will have a cap/cover are 4,100 mg/kg and 530 mg/kg, respectively. Justification of this decision is included in Appendix H.

6.5.6 Offsite Disposal at a Landfill

This option involves excavation of soil above the CLs, transport, and off-Site disposal. Soil would be characterized based on RI and confirmation sample results.

Effectiveness:

- Protectiveness: Off-Site disposal would be effective in meeting the cleanup standards for the Site as listed in WAC 173-340-700. The timeframe necessary to complete this action is approximately 7.6 years.

- Permanence: Since no soil exceeding the cleanup standards would remain on-Site, volume and toxicity would be reduced on-Site but not at the disposal facility. This alternative represents a permanent solution.

- Long Term Effectiveness: This alternative is effective for the Site. Soil would have to be managed at the disposal facility over the long-term.

- Management of Short Term Risks: This alternative would involve the greatest amount of excavation and hauling of any of the retained alternatives. As such, the risks from dust and truck traffic would increase proportionally. An aggressive dust control program and air monitoring could minimize short-term risk to dust exposure. These efforts have been successful in the past in controlling potential risks. The high volume of truck traffic could cause a significant amount of added risk.

- Consideration of Public Concerns: Trucking of the soil off-Site would require approximately 44,000 truckloads over 5.6 years. Truck traffic has been an issue with the public in the past.

Implementability: This alternative can meet the current needs of the Site development plans. It can be implemented using standard excavation practices.

Cost: A direct cost range of $181M to $248.8M is estimated for implementation of this alternative.

Considerations: This alternative represents the highest reasonable cost for remediation of the Site. Implementing more costly alternatives to remediate the Site would not be warranted. No volume reduction would be attained by this alternative. It is, however, the most permanent and will be retained for further evaluation in Chapter 7.

Adjustments to remediation levels: No adjustments to the remediation levels used in the RA are warranted for this alternative.

6.5.7 Wet Screening, Classification, and Disposal of the Residual Soils at a Landfill

This option includes the excavation of soil above CLs, wet screening the soil into at least two soil fractions, and deposition of the clean coarser fraction on the Site. The concentrated finer fractions would be disposed of at a landfill. The results of the 2001 Screening Program and an evaluation of the treatability study data, presented in Chapter 5, indicates that the cut point for generating a clean coarse fraction and a concentrated finer fraction will depend on the initial contaminant concentration in the soil. For the purposes of evaluation, this FS considered this cut point to be ½ inch. As such, total volume of soil requiring off-Site disposal is likely to be approximately 76 percent. The residual soil could require stabilization at the landfill. No on-Site deposition of soils above the CLs would occur under this alternative. No cover or cap would be used.

Effectiveness:

- Protectiveness: Classification and off-Site disposal could be effective in meeting the cleanup standards for the Site as listed in WAC 173-340-700. The timeframe necessary to complete this action is approximately 4.4 years.

- Permanence: Since no soil exceeding the cleanup levels would remain on Site, volume and toxicity would be reduced on-Site but not at the disposal facility. This alternative represents a permanent solution.

- Long Term Effectiveness: Since all soil contaminant concentrations on-Site would not exceed cleanup standards, this alternative would be effective long-term. Soil shipped off-Site would have to be managed at the disposal facility over the long-term.

- Management of Short Term Risks: All wet screening and soil washing alternatives represent an increase in materials handling compared to other retained alternatives. As such, the risks from dust increase proportionally. An aggressive dust control program and air monitoring could minimize short-term risk to dust exposure. These efforts have been successful in the past in controlling potential risks.

- Consideration of Public Concerns: Trucking of the soil off-Site would require approximately 34,000 truckloads over 4.0 years. Truck traffic has been an issue with the public in the past.

Implementability: This alternative could be implemented using existing soil treatment and handling technologies. Disposal of contaminated fines soil at a landfill could be implemented but would require up to 34,000 truckloads. Based on data from 2001 Screening Program, water generated by the wet screening process could be filtered to remove suspended contaminants and recycled.

Cost: A direct cost range of $61.9M to $110.6M is estimated for implementation of this alternative. As a conservative approach, it was assumed that the residual material would require stabilization at the landfill. Wet screening and a classification cut point of ½ inch (24 percent volume reduction) were used in the cost evaluation.

Considerations: This alternative has the potential for significant soil volume reduction, is permanent and uses conventional soil handling technologies. It is, however, a time consuming and expensive process that would cause significant public concern (truck traffic). Since the time, benefit and increased public concern outweigh the benefits (vs. similar volume reduction alternatives) it will not be retained for further evaluation.

Adjustments to remediation levels: No adjustments to the remediation levels used in the RA are warranted for this alternative.

6.5.8 Wet Screening with On Site Deposition, Cover and Cap and Disposal of the Residual Soils at a Landfill

This option includes the excavation of soil above Site-specific RLs, wet screening the soil to separate it into "clean" and contaminated fractions, off-Site disposal of the contaminated fines, and the deposition and cover/cap of the clean, coarser fraction on the Site.

Wet screening the soil into two soil fractions, one larger and one smaller than about -200 mesh, will generate a clean coarser fraction and a concentrated finer fraction which could be disposed of at a landfill. Since the finer fraction of soil from the wet screening operation will contain higher concentrations of lead or arsenic than the excavated, untreated soil, stabilization may be required at the landfill. The results of the 2001 Screening Program indicates that the total volume of soil requiring off-Site disposal is likely to be less than 10 percent.

The coarse "clean" fraction would be transferred to discrete locations within the golf course land use areas and covered with an 18-inch thick cap/cover combination to prevent exposure. The cap would consist of a layer of high durability, engineered materials or layer of gravel placed over the deposited soils or soils which contain contaminant concentrations above the CL but below the RL. A soil cover would then be placed on top of the cap to further prohibit exposure to the underlying soils. The installation of the cap/cover would meet the RAOs by preventing direct contact exposure with soil above the CL.

Effectiveness:

- <u>Protectiveness:</u> This alternative could be effective in meeting the cleanup standards for the Site as listed in WAC 173-340-700. Although mobility and toxicity are not modified, volume would be reduced and the soil would be placed in a land use area where the exposure risks are reduced. The timeframe necessary to complete this action is approximately 3.6 years.

- <u>Permanence:</u> There would be no reduction in toxicity or mobility. This alternative is not a permanent remedy.

- <u>Long Term Effectiveness:</u> Once complete, this alternative would greatly reduce residual risk. Long-term effectiveness of a cap/cover remedy relies on an effective O&M program. Such programs can be effective with active management. This alternative is particularly applicable within the golf course land use areas since the operations of a golf course would ensure the competence of the cap/cover.

- <u>Management of Short Term Risks:</u> All wet screening, and soil washing alternatives represent an increase in materials handling compared to other retained alternatives. As such, the risks from dust increase proportionally. An aggressive dust control program and air monitoring could minimize short-term risk to dust exposure. These efforts have been successful in the past in controlling potential risks.

- <u>Consideration of Public Concerns:</u> No additional public concerns are anticipated.

Implementability: If on-Site deposition is restricted to discrete areas within the golf course land use area, treeless open space, and historical land use areas this alternative can meet the current needs of the Site development plans and can be easily implemented using conventional soils excavation, handling, and transportation equipment.
Cost: A direct cost range of $59.9M to $99M is estimated for implementation of this alternative.

Considerations: This alternative has the potential for significant soil volume reduction, and uses conventional soil handling technologies. It is a less time consuming and expensive process than similar volume reduction alternatives and would reduce public concern over truck traffic. This alternative provides for placing soil in land use areas associated with lower exposure risks. Future Site development restrictions due to soil covers may be limited to the golf course areas only. Since this alternative has benefits in time, cost and decreased public concern (vs. similar volume reduction alternatives) it will be retained for further evaluation.

Adjustments to remediation levels: A key component of this alternative is the installation of an 18-inch soil cap/cover (as described in Section 7.2.3) The risk-based remediation or cleanup levels used in the RA for soil located within the golf course and open space land use areas are based on frequency of exposure and do not consider the installation of a soil cover over impacted soil. The application of an engineered cap/cover will further reduce the potential risk of exposure thereby increasing the effective RL. Ecology has determined that the effective remediation levels for lead- and arsenic-contaminated soils in areas of the Site that will have a cap/cover are 4,100 mg/kg and 530 mg/kg, respectively. Justification of this decision is included in Appendix H.

6.5.9 Wet Screening with Stabilization and On-Site Deposition and Cap/Cover

This option includes the excavation of soil above the RL, wet screening of the soil, stabilization of the contaminated fraction, and deposition and cover/cap of the clean, coarser fraction on the Site.

Wet screening the soil into two soil fractions, one larger and one smaller than about -200 mesh, will generate a clean coarser fraction and a concentrated finer fraction which would require stabilization prior to deposition. The results of the 2001 Screening Program indicate that the total volume of soil requiring stabilization is likely to be less than 10 percent.

Both the coarse “clean” fraction and the stabilized material would be transferred to discrete areas within the golf course land use areas and covered with an 18-inch thick cap/cover combination to prevent exposure. The cap would consist of a layer of high durability, engineered materials or a layer of gravel over the deposited soils or soils which contain contaminant concentrations above the CL but below the RL. A soil cover would then be placed on top of the cap to further prevent exposure to the underlying soils. The installation of the cap/cover would meet the RAOs by preventing direct contact exposure with soil above the CL.

Effectiveness:

- Protectiveness: Wet screening would be effective in reducing the volume of contaminated soil on Site. It would not lower contaminant concentrations in the fines (the concentration would increase) and thus would not meet the cleanup standards for Site soils. Stabilization of the finer fraction would reduce leachability/mobility and, if placed into a monolithic unit, would reduce the total surface area available for direct contact. The timeframe necessary to complete this action is approximately 3.7 years.

- Permanence: Mobility and volume would be reduced. Toxicity would not be addressed. Since this alternative would not meet cleanup standards, this is not a permanent solution.

- Long Term Effectiveness: This alternative is effective long-term in reducing leachability and, since it is combined with a cover, somewhat reduces the risk of long-term exposure. Long-term effectiveness of a cap/cover remedy relies on an effective O&M program. Such programs can be effective with active management. This alternative is particularly applicable within the golf course land use areas since the operations of a golf course would ensure the competence of the cap/cover.

- Management of Short Term Risks: All wet screening and soil washing alternatives represent an increase in materials handling compared to other retained alternatives. As such, the risks from dust increase proportionally. An aggressive dust control program and air monitoring could minimize short-term risk to dust exposure. These efforts have been successful in the past in controlling potential risks.

- Consideration of Public Concerns: No additional public concerns are anticipated.

Implementability: Both stabilization and wet screening are conventional technologies and the implementation of these technologies in combination would not require special considerations. This alternative can meet the current needs of the Site development plans. Monitoring of the stabilized soil may be required.

Cost: A direct cost range of $46.6M to $84M is estimated for implementation of this alternative.

Considerations: This alternative does not meet cleanup standards and will not retained for detailed analysis.

Adjustments to remediation levels: No adjustments to the remediation levels used in the RA are warranted for this alternative.

6.5.10 Soil Washing with Wet Screening, Classification, Acid/Base Extraction, and Disposal of the Residual Soils at a Landfill

This option includes the excavation of soil above the RL, wet screening the soil at about 4 mesh (6 mm), deposition of the clean coarser fraction on the Site, further classification of the -10 mesh soil to separate a concentrated fine residual fraction (approximately -200 mesh), acid or base extraction of metals from the -10 mesh to +200 mesh fraction, deposition of the cleaned fraction on-Site, and disposal of the -200 mesh fraction at a landfill. Treatability studies indicate that acid extraction of soil containing lead can be attained using an acid mixture with a pH range from 1 to 3. Arsenic is more leachable under base conditions between pH 10 and pH 12. These extraction methods, in combination with classification, may be effective in cleaning impacted soil, and returning about 90 percent of the soil to the Site. Note that a lower classification cut point of 200 mesh (vs. 100 mesh) was selected to enhance metals recovery in the -10 mesh +200 mesh fraction using extraction chemicals. Metals extracted by this alternative would be precipitated and disposed of at a landfill along with non-metal sludge that may accumulate.

Effectiveness:

- Protectiveness: This alternative could be effective in meeting the cleanup standards for the Site as listed in WAC 173-340-700. Soil Washing would be effective in reducing the volume of contaminated soil. Acid extraction would be effective for soils containing lead only, and base extraction would be effective for soils containing arsenic only. No soil above CLs would remain on the Site. The timeframe necessary to complete this action is approximately 5.5 years.

- Permanence: Since no soil above CLs would remain on the Site, this is a permanent solution.

- Long Term Effectiveness: This alternative is effective long-term.

- Management of Short Term Risks: All wet screening and soil washing alternatives represent an increase in materials handling compared to other retained alternatives. Soil washing adds an additional risk associated with the handling of treatment chemicals. As such, the risks from dust increase proportionally. Aggressive chemical handling and dust control programs and air monitoring could minimize short-term risk. These efforts have been successful in the past in controlling potential risks.

- Consideration of Public Concerns: No additional public concerns are anticipated.

Implementability: Soil washing technologies (wet screening, classification, and acid/base extraction) use common processes, and the implementation of these technologies in combination would not require special considerations. This alternative can meet the current needs of the Site development plans and no soil above the RLs would remain on Site. Handling of acids and bases during the treatment process would require special precautions. No commercial application of base extraction of soils containing arsenic is known.

Cost: A direct cost range of $76.9M to $120M is estimated for implementation of this alternative. The -200 mesh soil and precipitated concentrates (10% of whole soil) would be disposed of off-Site as a characteristic hazardous waste.

Considerations: This alternative has the potential to reduce volume, toxicity, and mobility. Additionally, a low volume of material would require off-Site disposal. Acid/base handling on the Site may reduce the short-term effectiveness. It is, however, a time consuming and expensive process that could also be ineffective short-term due to acid/base handling on the Site. Since these factors outweigh the benefits (vs. similar volume reduction alternatives) it was not retained for further evaluation.

Adjustments to remediation levels: No adjustments to the remediation levels used in the RA are warranted for this alternative.

6.5.11 Soil Washing with Wet Screening, Classification, Chelant Extraction, and Disposal of the Residual Soils at a Landfill

This option includes the excavation of soil above the RL, wet screening the soil at about 4 mesh (6 mm), deposition of the clean coarser fraction on the Site, further classification of the -10 mesh soil to separate a concentrated fine residual fraction (approximately -200 mesh), chelant extraction of metals from the -10 mesh to +200 mesh fraction, deposition of the cleaned finer fraction in the excavation or other on-Site area, and disposal of the -200 mesh fraction at a landfill. Note that a lower classification cut point of 200 mesh (vs. 100 mesh) was selected to enhance metals recovery in the -10 mesh +200 mesh fraction using extraction chemicals. Metals extracted by this alternative would be precipitated and disposed of at a landfill along with any non-metal sludge that may accumulate. Recycling of the extracted metals and -200 mesh fraction may be implemented if this material can meet the strict requirements of the thermal recycling vendors (smelters).

Effectiveness:

- <u>Protectiveness:</u> Soil Washing may be effective in reducing the volume of contaminated soil on site. Chelant extraction has been implemented effectively on soil containing lead. Recent research being performed with soil washing technology indicates that arsenic extraction using a chelant is questionable. The effectiveness of this alternative in treating Site soils with lead or arsenic is therefore uncertain. No soil above cleanup standards would remain on the Site. The timeframe necessary to complete this action is approximately 5.5 years.

- <u>Permanence:</u> Since no soil above CLs would remain on the Site, this is a permanent solution.

- <u>Long Term Effectiveness:</u> This alternative is effective long-term.

- <u>Management of Short Term Risks:</u> All wet screening and soil washing alternatives represent an increase in materials handling compared to other retained alternatives. Soil washing adds and additional risk associated with the handling of treatment chemicals. As such, the risks from dust increase proportionally. Aggressive chemical handling and dust control programs and air monitoring could minimize short-term risk. These efforts have been successful in the past in controlling potential risks.

- <u>Consideration of Public Concerns:</u> No additional public concerns are anticipated.

Implementability: Wet screening and classification can be readily implemented using common soil treatment and handling technologies. This alternative can meet the current needs of the Site development plans and no soil above the CLs would remain on the Site. The implementation of this alternative on soil impacted by arsenic would be considered innovative and the implementation would require significant effort during the start-up period. Handling of chelants could require special precautions.

Cost: A direct cost range of $75.3M to $120M is estimated for implementation of this alternative. The -200 mesh soil and precipitated concentrates (10% of whole soil) will be disposed of off-Site as a hazardous waste.

Considerations: This alternative may be effective in treating lead soil, but is has questionable effectiveness and implementability for arsenic only soil. It is also a time consuming and expensive process that could also be ineffective short-term due to chelant handling on the Site. As such, it will not be retained for further analysis.

Adjustments to remediation levels: No adjustments to the remediation levels used in the RA are warranted for this alternative.

6.6 Ranking of Alternatives

Ranking of the alternatives, described and discussed in Section 6.4, was conducted using the criteria defined in Section 6.2. The project team independently ranked the alternatives and the results were compiled into a single ranking for each alternative (Appendix E). This allowed the semi-quantitative ranking of the best and least favorable alternative for the particular criterion.

Different weightings were applied to the criteria to examine the sensitivity of the ranking results as the weightings were varied. For lead- and arsenic-impacted soils, the weighting factor had a small effect on the overall ranking of the alternatives. The alternatives were close in each case and the highest ranked alternatives still ranked high following the application of different weightings.

6.7 Summary of Selected Alternatives

No Action and three remedial alternatives of the eleven described and evaluated in this chapter were retained for further detailed analysis in Chapter 7. The alternatives retained for detailed analysis were:

- No Action;
- Off-Site Disposal at a Landfill;
- On Site Deposition, Cap and Cover; and
- Wet Screening with On-Site Deposition, Cap and Cover and Disposal of the Residual Soils at a Landfill

Four additional alternatives were retained for small scale or “spot” applications. These were:

- Cap;
- Cover;
- Cap/Cover; and
- Off-Site Disposal at a Landfill.

The selection of each of the alternatives was based on the ability of the alternative to provide a higher level of effectiveness, implementability, and/or lower cost than other alternatives that use similar technologies. This results in the best alternatives for each technology being retained for the detailed analysis. Two of the alternatives (No Action and Off-Site Disposal at a Landfill) were retained for cost comparison.

A summary of why each of the alternatives was retained is presented below.

6.8 Retained Alternatives: Large Scale Applications

No Action: Even though it does not meet cleanup standards by either the criteria listed in WAC 173-340-700 or WAC 173-340-7490(6)(f), the No Action alternative was retained for comparative purposes. It represents the low cost alternative.

Off-Site Disposal at a Landfill: This alternative meets cleanup standards and is permanent (for the Site). It was, therefore, retained for further evaluation. This alternative also represents the highest reasonable cost, which would be incurred by a cleanup action. This alternative represents the high cost option.

On Site Deposition, Cap and Cover: This alternative meets cleanup standards, meets RAOs, minimizes risks, is easily implemented, and represents reasonable costs. It is the most protective of the containment (cap or cover) alternatives and was, therefore, retained for further evaluation.

Wet Screening with On-Site Deposition, Cap and Cover and Disposal of the Residual Soils at a Landfill: This alternative represents the most practical of the volume reduction alternatives. It is effective (meets cleanup standards), is easily implemented, has been proven to be successful (2001 Screening Program), has the lowest overall cost and represents the lowest short-term risk of this group of technologies. For these reasons this alternative was retained for further evaluation.

6.9 Retained Alternatives: Small Scale Applications

Even though large-scale applications of the following technologies may be either ineffective (do not meet RAOs) or are overly expensive for the benefit they offer, they may be appropriate for Miscellaneous Small Units. They will be evaluated further in Section 8.3.

- **No Action:** No Action may be appropriate in locations where special considerations apply. These areas could include those areas of environmental sensitivity, special cultural significance or locations of contaminants that meet certain criteria.

- **Cap:** Asphalt capping may be appropriate where trails, or parking lots are planned. Limited use of this technology would meet cleanup standards, be protective long-term (with active maintenance) and is cost effective.

- **Cover:** A thick soil cover may be appropriate where disturbance of in-situ soils could cause significant harm to areas of environmental sensitivity, or special cultural significance.

- **Cap/Cover:** The application of a cap/cover (as described in Section 7.2.3) may be appropriate where an exposure barrier is desired. This technology is as appropriate for in-situ soils as it is for areas of soil deposition especially in areas of special cultural significance.

- **Off-Site Disposal at a Landfill:** Excavation and disposal of small volumes of contaminated soils could be appropriate. This technology has particular value in remediating “Miscellaneous Small RUs”.

TABLE 6-1 - ESTIMATED LOW AND HIGH RANGE UNIT COSTS

LOW RANGE UNIT COSTS ALTERNATIVE	APPROX. TOTAL COST ($)
No Action	$0
Cover	$43,200,000
Capping	$79,200,000
Cap/Cover	$21,600,000
On-site Deposition with Cap/Cover	$13,248,000
Off-site Disposal at Landfill	$181,296,000
Soil Washing with chelants and offsite disposal	$75,312,000
Soil Washing with acid and offsite disposal	$76,896,000
Wet Screening with Stabilization, On Site Deposition, Cap/Cover	$46,656,000
Wet Screening, Classification and Disposal at Landfill	$61,920,000
Wet Screening, On-site Deposition, Cap/Cover and Off-Site Disposal	$59,904,000

HIGH RANGE UNIT COSTS ALTERNATIVE	APPROX. TOTAL COST ($)
No Action	$0
Cover	$72,000,000
Capping	$129,600,000
Cap/Cover	$41,472,000
On-site Deposition with Cap/Cover	$21,600,000
Off-site Disposal at Landfill	$248,832,000
Soil Washing with chelants and offsite disposal	$120,096,000
Soil Washing with acid and offsite disposal	$120,096,000
Wet Screening with Stabilization, On Site Deposition, Cap/Cover	$84,096,000
Wet Screening, Classification and Disposal at Landfill	$110,592,000
Wet Screening, On-site Deposition, Cap/Cover and Off-Site Disposal	$99,216,000

Figure 6-1 – Relationship of Screening Criteria to the Evaluation Criteria